# A Wire Log Periodic Dipole Array

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If you are looking for a HF antenna which has multi-band coverage with high gain, requires no retuning when switching bands nor any complicated feedline matching adjustments or ground radial systems. Then it would be hard to beat the log periodic system.

Military and commercial HF installations make extensive use of this type of antenna, and commercial models are available[1] which provide around 8-13dBi gain over the range 2-30MHz at SWR of less than 2.5:1.

As in all things, nothing this good comes without some disadvantages. The main ones are lack of rotational capability and the requirement for a large extent of real estate with two elevated supports. But depending on what is available a useful compromise can usually be reached. As I already had a vacant 35m by 16m block with a 10m mast behind my house, the LPDA was an attractive proposition. By running the antenna from one corner of the block to the mast I could aim the antenna along a bearing of 285∞, which would good coverage of the Middle East, North Africa, Europe and the Caribbean (long path).

The next step was to design an array which would fit into the space available. The first consideration was the minimum frequency to be covered. Some rough measurements on a scale diagram showed that the maximum length half element I could use would be around 12 metres, so 7MHz would be the practical lower frequency limit. The upper frequency limit was chosen to be 29MHz, this being the end of the 10m band for SSB operation.

Consulting the trusty ARRL Antenna Book [2], the section on log periodic design was thoroughly digested and transformed into an Excel spreadsheet so that the range of design parameters could be quickly examined. the basic design process for a log periodic is to start with optimum values for the design constant t (tau) and spacing constant s (sigma), and calculate the resulting element lengths and spacing. The total length of the system is dependent on the design constants and the bandwidth. this is constrained by the maximum distance between the two support points. Some trial and error is therefore required in order to obtain the maximum gain within the physical space available. The final design I arrived at is shown in Table 1.

**LOG PERIODIC ARRAY DESIGN**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | ZT | 5.357 | | | |
| F max. | 29 | *MHZ | BOOM | 34.806 | metres | | HALF |
| F min. | 7 | *MHZ | No. ELEM | 13.690 | | SPACING | ELEMENT |
| tau | 0.857828 | *INPUT | L1 | 21.429 | S1 | metres | 10.714 |
| sigma | 0.134706 | * | L2 | 18.382 | S2 | 5.773 | 9.191 |
| alpha | 14.78 | degrees | L3 | 15.769 | S3 | 4.952 | 7.884 |
| APEX < | 29.56 | degrees | L4 | 13.527 | S4 | 4.248 | 6.763 |
| BW ar | 1.6898638 | | L5 | 11.604 | S5 | 3.644 | 5.802 |
| Bs | 7.0008642 | | L6 | 9.954 | S6 | 3.126 | 4.977 |
| EL. DIAM | 0.67 | mm | L7 | 8.539 | S7 | 2.682 | 4.269 |
| Ro | 208 | Ohms | L8 | 7.325 | S8 | 2.300 | 3.662 |
| Zav | 698.72 | Ohms | L9 | 6.283 | S9 | 1.973 | 3.142 |
| sigma1 | 0.15 | | L10 | 5.390 | S10 | 1.693 | 2.695 |
| Zo | 267.92 | Ohms | L11 | 4.624 | S11 | 1.452 | 2.312 |
| FEEDER | 1 | *mm | L12 | 3.966 | S12 | 1.246 | 1.983 |
| SPACING | 4.67 | mm | L13 | 3.402 | S13 | 1.069 | 1.701 |
| | | | L14 | 2.919 | S14 | 0.917 | 1.459 |
| | | | L15 | 2.504 | S15 | 0.786 | 1.252 |
| | | | L16 | 2.2148 | S16 | 0.675 | 1.074 |
| | | | TOTAL | 133.112 | | 35.076 | |

Table 1

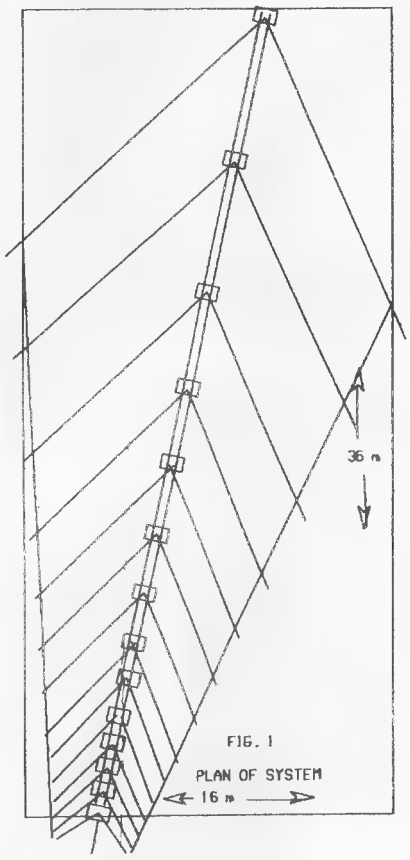


Figure 1

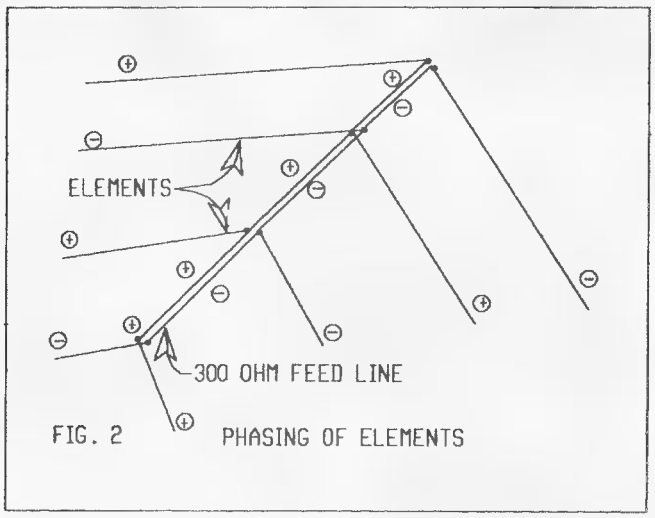


Figure 2

A further development in squeezing the maximum amount of antenna into the space available is to arrange the elements into a V shape rather than the straight line configuration [See figure 1]. the angle of the V is not critical but should probably not be less than about 85∞ for good performance and SWR. (The final angle in my installation was about 90∞)

Construction of the antenna basically follows the procedures given in the ARRL Antenna Book [2]. The elements were made with insulated 0◊7mm single strand copper wire. Since there is little strain on the wire on the element wires , relatively thin wire can be used. When it came to making the feedline, I simply used black 300W TV ribbon rather than constructing a twin-lead line at the calculated spacing of 4◊7mm. The effect on the SWR of the system was not expected to be significant.

Insulator blocks at the feed point of each element were cut from 7mm thick polypropylene cutting boards, and the element wires were sealed to the blocks with hot melt glue. Alternative elements must be connected to the feedline in reverse phase as shown in figure 2. At the forward (small) end of the antenna, a 4:1 balun was used to connect to the 50W coax from the transmitter. The entire feedline and insulator blocks were taped to a 36m length of UV resistant synthetic rope to support the weight of the antenna without straining the feedline.

At the outer ends of the elements, small blocks of propylene cutting board were used to attach the elements to the side spreader ropes. The ropes were supported at each end by 4 metre lengths of light wall galvanised tube secured to convenient fence posts. The blocks had hols drilled to allow them to slide along the rope after the ropes were tightened.

The fully assembled antenna was laid out on the ground and the central supporting rope was raised at each end. The side spreader ropes were tightened and the ends of the elements adjusted to remove slack and align each element in parallel with the others. The end blocks were then secured to the ropes with a small tie wire to prevent slippage in the wind.

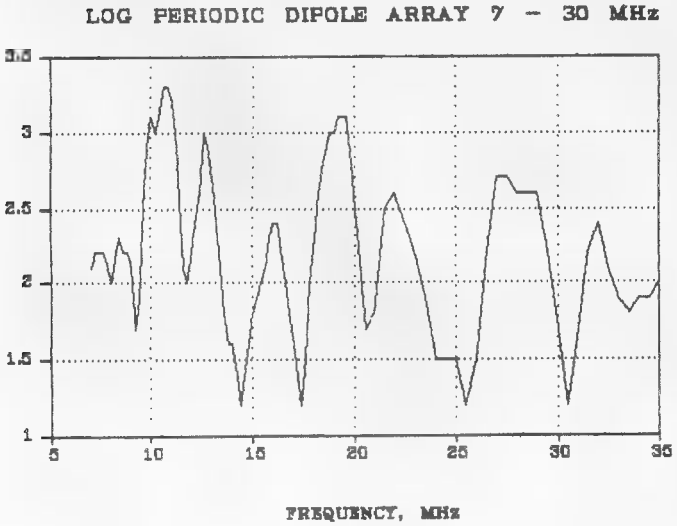


Figure 3

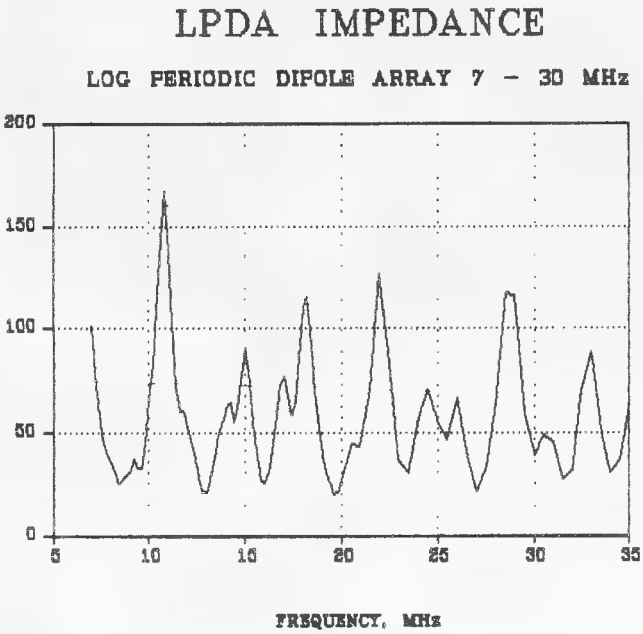


Figure 4

The SWR and impedance characteristics of the completed antenna as measured with an Autek RF-1 analyser as shown in figures 3 & 4. No adjustments were required at the antenna to obtain these results. As mentioned at the beginning, this antenna has a high gain (theoretical 5dB over a dipole), covers all frequencies from 7 to 29MHz, requires no tricky matching or tuning adjustments and no adjustments when changing bands. It does need a relatively large area in which to erect it and is not easily rotatable. Although if sufficient ground space is available even rotation would be possible! I will leave that to your imagination if you have the spare real estate

## References:-

[1] Radio Frequency Systems WLP 230, WLP330, WLP 400

[2] ARRL Antenna Book 18th edition section 10-1 to 10-9

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